Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 2 and 25 of the	)	ET Docket No. 98-206
Commission's Rules to Permit Operation	)	RM-9147
of NGSO FSS Systems Co-Frequency with	)	RM-9245
GSO and Terrestrial Systems in the Ku-	)	
Band Frequency Range	)	
and	)	
Amendment of the Commission's Rules	)	
to Authorize Subsidiary Terrestrial Use	)	
of the 12.2-12.7 GHz Band by Direct	)	
Broadcast Satellite Licensees	)	
and Their Affiliates	)	

COMMENTS OF DIRECTV, INC.

DIRECTV, Inc. ("DIRECTV")[1] hereby offers the following comments in connection with the Commission's Notice of Proposed Rulemaking ("Notice") in the above-captioned proceeding.

I. INTRODUCTION AND SUMMARY

This proceeding, begun by separate petitions for rulemaking filed by SkyBridge L.L.C. ("SkyBridge") and Northpoint Technology ("Northpoint"), asks the geostationary satellite orbit ("GSO") industry in general, and U.S. Direct Broadcast Satellite ("DBS")[2] operators in particular, to consider the possibility of two new major sources of interference from space and

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1 DIRECTV is a wholly-owned subsidiary of DIRECTV Enterprises, Inc., a licensee in the DBS service and wholly-owned subsidiary of Hughes Electronics Corporation.

2 DBS is known internationally as Broadcast Satellite Service ("BSS"), and the terms are used herein interchangeably.

earth, respectively. For DIRECTV, the SkyBridge and Northpoint proposals each threaten to fundamentally jeopardize its use of the 12.2-12.7 GHz (downlink) and the 17.3-17.8 GHz (uplink) frequency bands that are the primary bands used to provide DBS service in the United States.

In response to SkyBridge's proposal, the Commission has sought comment on whether to allow NGSO service downlink operations in the 11.7-12.7 GHz bands, which would overlap with the entire 12.2-12.7 GHz band used for DBS downlinks. DIRECTV's grave concerns regarding the NGSO operations proposed by SkyBridge are well-established.[3] Any Commission decision to proceed with allocating spectrum for NGSO operations at 12 GHz, let alone to promulgate service rules and license NGSO systems, must ensure that existing and future DBS operations -- in which operators such as DIRECTV collectively have invested billions of dollars -- are not adversely affected. The Commission has agreed that "NGSO operations should not hinder the evolution of the DBS" service.[4]

If these objectives are to be achieved, the Commission cannot adopt the provisional equivalent power flux density ("epfd") values adopted at WRC-97 that purport to protect BSS operations at 12.2-12.7 GHz. These provisional limits were established without the benefit of extensive analysis by the affected user organizations, and in the 14 months that have

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3 *See, e.g.,* Application of SkyBridge L.L.C. for Authority to Launch and Operate the SkyBridge System, File Nos. 48-SAT-P/LA-97, 89-SAT-AMEND-97, Reply of DIRECTV, Inc., Hughes Communications, Inc. and Hughes Network Systems (Mar. 20, 1998); Petition to Deny of DIRECTV, Inc., Hughes Communications, Inc. and Hughes Network Systems (Dec. 15, 1997); Amendment of Parts 2.106 and 25.202 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems, RM No. 9147, Opposition of DIRECTV, Inc. (Aug. 27, 1997).

4 *Notice* at ¶ 58.

elapsed since WRC-97, have been shown to be wholly inadequate to protect BSS system operations. Thus, the Commission's explicit skepticism in the *Notice* that "we are not convinced that . . . the provisional epfd limits adopted by WRC-97 are adequate to protect the 45 cm dishes that are used in the U.S., especially if multiple NGSO FSS systems are deployed in this band,"[5] is fully justified.

Since WRC-97, however, significant progress has been made, not only in showing just how inadequate the provisional limits are, but also in determining what the limits should be to ensure adequate BSS protection in the event that NGSO operations are introduced at 12 GHz. In the comments that follow, and in the attached Technical Appendix A,[6] DIRECTV reports on its analytical work relative to epfd limits. DIRECTV also urges the Commission to recognize that much more work needs to be done in this area, and that significant concerns regarding the operational integrity of proposed NGSO systems, such as SkyBridge's, remain. These concerns must be addressed before any licensing of NGSO systems is permitted to occur. The stakes are simply too high for the DBS operators and their millions of subscribers, and for the state of multichannel video programming distributor ("MVPD") competition to cable television generally, for the Commission to introduce a potentially enormous interference source into the BSS downlink band without fully understanding the implications of such action.

In addition to the major interference risk and potential coordination burdens introduced by the prospective sharing of DBS downlink spectrum with NGSO systems, DIRECTV and other DBS operators are now also confronted with Northpoint, which proposes to

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5 *Id.* at ¶ 59.

6 Technical Appendix A is an update of Joint Task Group ("JTG") 4-9-11/321, a U.S. input document to the Joint Task Group.

introduce, on a nationwide basis, yet another enormous harmful interference source in the 12.2-12.7 GHz band. Northpoint wishes the Commission to accommodate its experimental, terrestrially-based wireless technology, which would re-use the 12.2-12.7 GHz frequencies in a manner that Northpoint claims would be effectively interference-free relative to DBS operations in the band. While Northpoint initially positioned its proposed service for political reasons as one that would be complementary to DBS, allegedly providing DBS subscribers with a source for local broadcast signals,[7] Northpoint now pitches its concept as a full-blown competitive MVPD service, proposing a "new terrestrial transport service in the 12.2-12.7 GHz band to deliver multi-channel programming and Internet services."[8]

DIRECTV has carefully reviewed the data filed by Northpoint in its experimental license reports. DIRECTV is greatly disturbed by Northpoint's claims of non-interference with BSS operations. For example, only last week, the President of Northpoint testified before Congress that, on the basis of its testing under a single experimental license in Austin, Texas, Northpoint has proven that its system "is viable" and does not "interfere with DBS."[9]

As set forth below and in the attached Technical Appendix B, that statement is absolutely unsupported, and DIRECTV believes, unsupportable. Indeed, DIRECTV's

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7 *See* Northpoint Petition for Rulemaking, RM-9245 (Mar. 6, 1998), at 2 ("Northpoint Petition").

8 Letter to Chairman William E. Kennard from multiple Broadwave entities (Jan. 11, 1999), at 1. Sixty-eight locally-based affiliates of Northpoint, operating under the name Broadwave USA, have filed license applications to deploy Northpoint service in all 211 local television markets. *Id.*

9 Statement of Sophia Collier, President and CEO, Northpoint Technology, Inc., before the House Commerce Subcommittee on Telecommunications, Trade and Consumer Protection (Feb. 24, 1999) ("Collier Testimony"), at 5.

conclusions, based upon eyewitness observation of Northpoint's testing and careful analysis of Northpoint's system descriptions and experimental data, are precisely to the contrary.

Among other things, DIRECTV's analysis shows:

- Using a sharing criterion that is consistent with the extensive international technical work being performed to resolve inter-service BSS sharing issues, the zone around a Northpoint transmitter where the interference level is unacceptable for BSS operations *occupies more than 50% of the proposed Northpoint service area.* It would be prohibitively costly and directly contrary to the DBS philosophy of utilizing consumer-friendly, easy-to-install antennas to rely upon some form of mitigation (such as shielding) to reduce this interference for all BSS receivers within such a large area.

- The experimental data relied upon by Northpoint to support its assertions of non-interference are highly suspect. DIRECTV representatives were present during portions of Northpoint's testing in Austin, Texas, and DIRECTV has carefully analyzed Northpoint's experimental progress reports. Northpoint makes numerous assertions in these reports that are clearly erroneous and that demonstrate *a complete lack of understanding of the complex technical issues involved* with the harmful interference effects of the Northpoint system on the provision and receipt of high-quality DBS service.

- Northpoint's test data, even when accepted at face value, show that DIRECTV's service link availability was seriously degraded during the Northpoint tests. The test data clearly show interference levels that are higher than will be allowed for an NGSO FSS system operating under new internationally agreed-to sharing criteria. These high interference levels were present *at all but one of Northpoint's test sites,* in complete contradiction of Northpoint's claims. Northpoint's test data show that, if its system is deployed, it will interfere with DBS operations.

Northpoint has completely failed to show that its system can co-exist with the DBS service without causing unacceptable levels of interference to U.S. DBS operations. Because of DIRECTV's substantial "clear weather" signal margins, Northpoint signals may not

always cause visible disruption to DIRECTV's digital signals. However, in a wide variety of cases, Northpoint system interference will lower DIRECTV's clear weather margins and increase downlink rain outages. These increased DIRECTV outage periods will cause the service to appear more "on par" with cable system availability -- which is inferior to DIRECTV service availability. DIRECTV plans to improve its service availability as cable companies move to more modern digital networks; deployment of Northpoint technology at 12 GHz thus threatens to severely adversely affect DIRECTV's future competitiveness with incumbent cable monopolists.

DIRECTV also fails to perceive any material policy benefits of the Northpoint system that can possibly outweigh the dramatic interference risks it poses. Northpoint essentially plans to re-package existing technology in an unproven terrestrial wireless application to offer MVPD services. *Northpoint has shown no particular reason why it must use the 12 GHz band -- the most mission critical of all frequencies used by DBS operators -- as opposed to other frequency bands that could be made available for its proposed secondary terrestrial operations.* Both the MDS and LMDS frequency bands have already been allocated for the types of services that Northpoint proposes, and there may be other candidate spectrum as well. Furthermore, there is little reason to link Northpoint's service to the 12 GHz band now that Northpoint has announced plans to enter the MVPD marketplace as a standalone competitor rather than a DBS-complementary service. Indeed, as a direct competitor to DIRECTV, Northpoint will have every incentive to dispute claims of harmful interference by its system with DBS operations, notwithstanding Northpoint's proposed secondary status in the 12 GHz band.

The thrust of Commission policy in promoting the development of DBS service over the past two decades has been to transition terrestrial interference sources *out* of the 12 GHz

band, not to re-introduce them.[10] DBS has been recognized by the Commission hands down as the service that offers the most powerful source of competition to incumbent cable television operators. DBS systems in the United States only became operational in the United States in 1994, yet the service already has more than eight million U.S. subscribers, the Commission has declared it to be the "single largest competitor to cable operators" and the service "continues to show strong growth."[11] Thus, although Northpoint's goal of seeking to promote competition to incumbent cable television operators is a worthy one,[12] DIRECTV strongly objects to the use of the U.S. DBS industry's most critical frequency band to introduce a terrestrial service that is certain to seriously degrade DBS operations. Certainly, there are other frequency bands that can accommodate Northpoint's technology without adversely impacting a mass-market service received by millions of consumers. The Commission should direct Northpoint to identify such alternative bands.

II. NGSO SYSTEM CO-EXISTENCE WITH GSO BSS OPERATIONS

A. Feasibility of NGSO/BSS Sharing

1. BSS downlinks at 12.2-12.7 GHz

At the outset, the *Notice* recognizes that the 12.2-12.7 GHz band is allocated for the provision of DBS service in Region 2, and that "[w]ith over 6 million subscribers in the U.S.,

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10 *See* Public Notice, *Initiation of Direct Broadcast Satellite Service -- Effect on 12 GHz Terrestrial Point-to-Point Licensees in the Private Operational Fixed Service*, 10 FCC Rcd 1211 (1994) (Relocation "of existing 12 GHz [terrestrial] users was deemed necessary because of the likelihood of interference that terrestrial use would cause to DBS service if both were operating in the same geographic area.").

11 *Annual Assessment of the Status of Competition in Markets for the Delivery of Video Programming*, CS Docket No. 98-102 (rel. Dec. 23, 1998), at ¶ 62.

12 *See Collier Testimony* at 7; Northpoint Rulemaking Petition at 7.

DBS is the closest competitor to the cable television industry for the provision of multichannel video program distribution services."[13] Preserving the interference-free use of these frequencies should be a priority of the Commission in considering any proposal to introduce NGSO operations in the 12 GHz band.

Along these lines, if the viability and continued development of BSS systems is to be preserved, the Commission must not adopt the provisional epfd values adopted at WRC-97 that purport to protect BSS operations at 12.2-12.7 GHz. As explained in Technical Appendix A, these provisional limits were established without the benefit of extensive testing or analysis. However, such analysis (which is still in progress) is essential because (1) BSS has been developed in the United States using technical parameters that are different from those listed in Annex 5 of Appendix 30 of the ITU Radio Regulations, and (2) the NGSO interference source is one whose interference signal varies widely with time.[14] In the 14 months that have elapsed since WRC-97, much progress has been made with respect to developing the technical assumptions necessary to revise the WRC-97 provisional limits to achieve realistic and adequate protection of BSS operations relative to NGSO systems if and when such systems are introduced into the 12 GHz band. This progress includes the establishment of appropriate BSS protection criteria, the development of an accurate methodology to evaluate candidate interference limits against the protection criteria, and a better understanding of the interference characteristics of NGSO systems as they interact with BSS operations.[15] In particular, BSS protection criteria and

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13 *Notice* at ¶ 55. DBS currently has more than 8 million subscribers. *See* SkyREPORT.com E-News, *Dish, DIRECTV Have Strong January* (Feb. 11, 1999).

14 Technical Appendix A at 1.

15 *Id.*

an evaluation methodology were proposed in a Preliminary Draft New Recommendation ("PDNR") written during the October 8, 1998 meeting of Joint Working Party ("JWP") 10-11S in Geneva, Switzerland. Each of DIRECTV and SkyBridge have developed implementations of the evaluation methodology described in the PDNR, and they agree closely with one another.[16]

Because of the time varying nature of the interference and the development of suitable evaluation tools, interference limits to protect BSS now have evolved into interference limit "masks" representing epfd.[17] These masks allow for more efficient accommodation of the needs of the GSO and NGSO communities, and DIRECTV believes that it is now possible to establish such masks in a manner that fundamentally protects primary BSS operations in the United States using 45, 60, 90, 120, 180 and 240 cm subscriber antennas.[18] However, DIRECTV also notes that basing interference limits on epfd also has certain drawbacks that must still be addressed. These include the need to define both aggregate and single entry masks, and the need to establish an effective number of operating NGSO systems in a given band.[19] In addition, the definition of epfd[20] stipulates that interference limit masks are dependent on the characteristics of the victim receiving antenna. This in turn will create a large set of interference limits for a given

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16 *Id.*

17 *Id.*

18 *Id.*

19 *Id.* at 2.

20 Epfd is the sum of the power levels of all possible interfering transmissions from all satellites in a particular NGSO constellation into a particular GSO earth station receiver. *Notice* at ¶ 4. A more detailed definition of epfd can be found at footnote 1 of annex to Resolution 538 (WRC-97).

band. These and other drawbacks still must be adequately addressed before the concept of epfd is adopted as the quantitative interference measuring parameter.

As explained in Technical Appendix A, based on the international research that has been performed to date (with DIRECTV and SkyBridge as key participants), DIRECTV has formulated an initial policy with respect to the derivation of suitable emissions masks to protect BSS operations in the United States:

1. The protection criteria as defined in the JWP 10-11S PDNR (and as modified by JTG 4-9-11 at its recent meeting in Long Beach, California) *must be met* for all BSS links.

2. Either of the two implementations of the PDNR evaluation methodology -- the DIRECTV implementation or the SkyBridge implementation -- may be used to evaluate candidate aggregate epfd limits.

3. For any given antenna size of interest, an aggregate interference limit mask that meets the requirements stated in points (1) and (2) above for all BSS links is acceptable, regardless of its shape. That is, the required amount of protection can be provided by a variety of mask shapes. (Some shapes are more accommodating of NGSO systems characteristics than other shapes.)

4. Single entry interference masks are derived from an acceptable aggregate mask shape. This is done using an assumed number of NGSO FSS systems that could share the same spectrum. A strong regulatory mechanism is needed to ensure that whatever the eventual number of operating NGSO systems proves to be, the aggregate limit is never exceeded.[21]

The protection criteria established by JWP 10-11S, the evaluation methodology and its implementation by DIRECTV, the inadequacy of the WRC-97 provisional limits, the derivation of a candidate mask shape, and proposed interference limit masks are all described in more detail in Technical Appendix A. DIRECTV believes that the above policy must be adopted to protect U.S. DBS operations. Moreover, the policy should be periodically monitored and

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[21] Technical Appendix A at 2.

updated, as more information becomes known about the permutations of NGSO-BSS sharing at 12 GHz.

2. BSS "Reverse Band" Operations at 17.3-17.8 GHz

In the Commission's pending blanket licensing proceeding, DIRECTV has urged the Commission to allocate the 17.3-17.8 GHz band in the United States for BSS downlinks, since this band is allocated internationally for that purpose in Region 2.[22] These reverse band working operations are expected to provide a critical source of additional BSS capacity.

Correspondingly, DIRECTV fully concurs with the Commission's conclusion that spectrum sharing "between ubiquitous BSS downlink to subscriber operations and NGSO FSS operations, both service and gateway links would not be possible."[23] Technical arguments to support such a conclusion can be found in ITU-R document 4-9-11/312, "Sharing Between BSS and non-GSO FSS (Earth-to-Space) in the 17.3 to 17.8 GHz Frequency Band in Region 2." This document, provided by the United States to the Joint Task Group ("JTG"), provides calculations on both the required coordination distance and the required separation distance between NGSO user terminals and BSS user terminals, and between NGSO gateway terminals and BSS user terminals. The coordination distance calculations take into account the time varying nature of the interference from NGSO FSS terminals, and the separation distance calculations also take

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22 *See Notice* at ¶ 47; *In the Matter of Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Band, and the Allocation of Additional Spectrum in the 24.75-25.25 GHz Frequency Bands for Broadcast Satellite Service Use*, IB Docket No. 98-172, RM Nos. 9005, 9118, Comments of DIRECTV Enterprises, Inc. (Nov. 19, 1998). DIRECTV also requested that the Commission allocate a portion of the 24 GHz band to the Fixed-Satellite Service ("FSS") for BSS feeder uplinks, on an exclusive, primary basis.

23 *Notice* at ¶ 48.

this time varying factor into account in the form of separation distance best case and worst case bounds.

In the case of sharing between NGSO user terminals and BSS user terminals, the ITU-R document concludes that sharing is not possible -- coordination and separation distances are both large, and this is fundamentally incompatible with the ubiquitous nature of both sets of terminals. The JTG, in document 4-9-11/temp/75, agreed with this assessment.

In the case of sharing between NGSO gateway terminals and BSS user terminals, the ITU-R document again shows that coordination and separation distances are large, and as a result, sharing between a large number of transmitting non-GSO FSS gateway terminals and millions of BSS user terminals would not be possible. The JTG concluded that "these separation distances may impose unacceptable constraints on the development of the BSS in the 17 GHz band if the number of NGSO gateways was to exceed a few per country."[24]

DIRECTV believes that such separation distances will impose unacceptable constraints on the development of the BSS at 17 GHz. The reverse band working allocation in this particular band was originally considered acceptable because the anticipated number of BSS feeder link stations was small. This assumption has proven to be true in the deployment of BSS feeder link stations across this country. There currently are approximately 6 feeder link sites across the country, and this number could shrink further in the future with BSS consolidation. Thus, if more than a very few NGSO gateway stations are allowed within the U.S., the coordination burden on BSS operators will rise significantly. Given that there will be multiple NGSO operators, and assuming that each is limited to even 2 gateway stations within the United

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24 JTG document 4-9-11/temp/75 (28 January 1999), at 1.

States, this implies 6 to 10 gateway stations across the U.S. for 3 to 5 NGSO operators. Thus a number as small as 2 gateway terminals per operator then doubles the coordination burden and doubles the number of transmitting earth stations in the band. This circumstance imposes undue constraints on BSS operations.

The burden is even more onerous when considering the amount of spectrum allocated to the BSS versus the amount of spectrum being requested by NGSO interests. The amount of spectrum below 40 GHz available for BSS downlink operations in Region 2 is only 1 GHz (12.2-12.7 GHz and 17.3-17.8 GHz). The frequencies that may be used for Region 2 BSS feeder links are the 17.3-17.8 GHz, and certain portions of the 24.75-25.25 GHz bands. Therefore, the total available spectrum for BSS and its associated feeder links in Region 2 is 1.5 GHz. In contrast, over 3 GHz of spectrum was identified for NGSO FSS use in each direction in each Region by WRC-97. It should be noted that the NGSO FSS will have co-directional access to the 12.2-12.7 GHz BSS band in Region 2.

The 12.2-12.7 GHz BSS band is a Planned band and as a consequence, the United States has been assigned certain orbital locations. The uses of additional orbit locations to serve the U.S. are difficult to implement because ITU Appendix S30 requires protection of all existing Plan assignments and pending modifications to the Region 2 Plan. Therefore the 17.3-17.8 GHz band is the only other band available for future BSS downlink use and it must be protected for this allocated service. Allowing NGSO gateway stations to operate at 17 GHz is clearly detrimental to the successful development of this important BSS spectrum resource.

B. The Commission Must Preserve The Ability Of GSO BSS Systems To Innovate And Evolve

1. Higher EIRP

DIRECTV is heartened that the *Notice* acknowledges the need for DBS services to evolve unhindered by NGSO FSS operations.[25] DIRECTV has repeatedly expressed the concern that the NGSO system parameters proposed by SkyBridge, and the restrictions that would be necessary to afford SkyBridge interference protection, have the potential to greatly limit the ability of DIRECTV and the GSO BSS community at large to continue the evolution of what are still relatively new systems and services.

As U.S. BSS providers continue rapidly to adapt their systems to the tremendous marketplace demand for upgraded technology and new and innovative services, they are virtually certain to need to operate their spacecraft at higher EIRP levels. Such power increases will substantially benefit consumers. Higher EIRPs will in the future allow GSO BSS operators to improve system performance, *e.g.*, by using more bandwidth-efficient modulations and coding schemes to provide higher transponder throughput, by providing service using even smaller size subscriber antennas, or by improving link availability to existing dishes.[26] U.S. BSS operators should be permitted to take full advantage of higher EIRP levels to provide such improved services to the public, and not lose any of this advantage to counteract added interference from NGSO or terrestrial sources.

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25 *Notice* at ¶ 58.

26 SkyBridge has assumed a reference 56 dBW EIRP for BSS satellites. *See* Opposition of SkyBridge, File Nos. 48-SAT-P/LA-97, 89 SAT-AMEND-97 (Feb. 20, 1998) ("SkyBridge Opposition"), Table IV-3. In fact, 56 dBW is not a worst case scenario for DIRECTV, which has 48 dBW at the edge of its system coverage.

Unacceptable interference levels from NGSO or terrestrial systems should not be allowed to restrict enhanced BSS or other GSO service capabilities. As a matter of policy, sharing criteria that are eventually adopted by the Commission to facilitate GSO co-existence with NGSO operations such as those that SkyBridge has proposed should not hinder higher GSO EIRP operation.

2. Telemetry, tracking and command systems

The GSO industry still is in the process of performing various analyses on the potential impact of NGSO systems on transfer orbit and on station telemetry and command operations of GSO satellites. DIRECTV has been particularly concerned about the impact of NGSO interference on TT&C operations. Since these concerns were raised, work on this issue has proceeded within JTG 4-9-11, and DIRECTV has been relying on the work of experts in that forum to address these concerns.

In particular, ITU-R document 4-9-11/85 from the United States presented a study of potential TT&C interference issues. The document showed that the interference concerns for the launch and deployment phase of TT&C operations can be effectively managed through coordination of operations. The *Notice* expresses a similar view, proposing that GSO and NGSO operators coordinate their transfer orbit operations, while emergency TT&C operations would be protected.[27] DIRECTV supports this proposal.

3. Aircraft mobile antennas

DIRECTV remains concerned that any sharing criteria ultimately adopted by the Commission address the impact of NGSO operations on new GSO business opportunities, such

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27 *Notice* at ¶ 62.

as DIRECTV's burgeoning efforts to market its DBS reception equipment to the private and commercial aviation market. SkyBridge's claim, summarized in the *Notice*,[28] that it has no legal obligation to worry about innovative BSS applications such as service to aircraft is without merit. Under both the Region 2 BSS Plan and the Commission's rules, BSS and DBS are both defined as a "radiocommunication service in which signals transmitted or retransmitted by space stations are intended for direct reception by the general public."[29] For purposes of this definition, "direct reception" encompasses both individual reception and community reception.[30] And with respect to geographic service, the Commission has granted DBS operators the flexibility to serve all areas within their coverage beams.[31]

GSO BSS service to aircraft, thus is encompassed within U.S. domestic and international definitions of DBS and BSS service.[32] BSS transmissions to aircraft are intended for direct receipt by the general public, and the aircraft environment clearly encompasses

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28 *Id.* at ¶ 61.

29 ITU Radio Reg. 37, Chapter 1; 47 C.F.R. § 100.3; *see Revision of Rules and Policies for the Direct Broadcast Satellite Service*, IB Docket No. 95-168 (rel. Dec. 15, 1995), at ¶ 12.

30 ITU Radio Reg. 37, Chapter 1.

31 *See Amendment of the Commission's Regulatory Policies Governing Domestic Fixed Satellites and Separate International Systems,* 11 FCC Rcd 2429 (1996), at ¶ 70.

32 SkyBridge has argued that DIRECTV's DBS service to aircraft should be analogized to non-conforming uses of FSS downlink frequencies. SkyBridge Opposition at 47; *see, e.g., USA Today Sky Radio*, 7 FCC Rcd 7493 (1992); *Qualcomm, Inc.*, 4 FCC Rcd 1543 (1989). SkyBridge's analogy is flawed, however, since DIRECTV's use of BSS frequencies is not non-conforming, but instead falls squarely within the scope of BSS service. The more proper analogy is to satellite DARS, which is the Commission's domestic implementation of ITU allocations for audio BSS. There, the Commission has expressly endorsed the primary use of BSS frequencies to serve mobile satellite DARS antennas (*e.g.,* mounted on cars) in addition to fixed antennas. *See Establishment of Rules and Policies for the Digital Audio Radio Satellite Service*, 12 FCC Rcd 5754 (1997).

individual or community reception. Moreover, such service is completely consistent with the initial charter of the DBS service allocation in the United States to expand and improve service to U.S. subscribers throughout the country.[33]

During the early technical discussions concerning NGSO interference issues, it was recognized that there might be a significant interference problem with aircraft mobile antennas. These links typically use receive antennas that are lower in gain than the common 45 cm antenna, and whose pattern is often that of a fan beam. These antenna characteristics are dictated largely by the aircraft environment. The concern is that the wide portion of the beam may admit significant amounts of interference from NGSO systems that are operating in the vicinity.

Early simulations of interference from the original SkyBridge 64-satellite constellation into such an antenna did indeed show that the interference levels are higher for such an antenna than would be found for a 45 cm antenna. Initial analysis of the effects of the long-term portion of the interference epfd curve (using characteristics of the SkyBridge 64-satellite constellation) indicated that there was not enough long-term noise added to cause a disruption in service. The impact on the aircraft link due to long-term low level interference is to cause the IRD front end error correction electronics to work somewhat harder at correcting transmitted bit errors caused by this added noise. This will not directly affect the displayed picture quality or audio quality if the added noise is sufficiently low, and because the aircraft are operating above the weather, this added stress on the receiver cannot be compounded by rain degradation.

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33 *See DBS Order*, 90 FCC 2d 676, 680 (1982)

However, initial analysis of the effects of the short-term portion of the interference epfd curve (again using characteristics of the SkyBridge 64-satellite constellation) indicated that in this case there can be sufficient noise added by NGSO systems to cause a service disruption. In a recent review of the data, it appears that the aircraft antenna beam shape can cause an amplification of high short-term levels of interference, which in turn could lead to loss of MPEG synchronization and loss of picture.

The mechanism under which this amplification occurs is not yet understood. To date, analytical efforts have been expended on protecting the 45 cm ground-based receive antenna. Given the advanced state of work in that area, DIRECTV believes that it is now prudent to return to the problem of the aircraft antenna and analyze it further. In particular, it would be useful to find a mechanism that translates epfd interference limit masks defined at more common antenna sizes to this particular mobile antenna situation. Then the initial findings discussed above can be confirmed for the more general NGSO interference case, and the results evaluated appropriately. In any event, however, it is extremely important that aircraft mobile operations be protected.

4. Impact of multiple NGSO systems

As explained in Technical Appendix A, it is vital for the FCC to adopt rules that reliably protect GSO BSS and FSS systems from the accumulated effects of multiple NGSO systems.[34] GSO operators must have reasonable assurance that aggregate limits will not be violated in the long term.

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[34] *See* Technical Appendix A at 33.

Fundamental to the protection of any GSO system is collective compliance by all NGSO systems with an aggregate interference limit. A central reason for developing such an aggregate limit is the uncertainty surrounding the number of NGSO systems and satellites that could ultimately share the NGSO space and spectrum resource.

Because DIRECTV believes that conservative estimations must be made at this time on the value for the maximum number "n" of NGSO systems that can be expected to share the same band, Technical Appendix A uses the value 5 for "n".[35] However, work to provide a definitive value for "n" has been inconclusive at best, and serious issues surrounding the implementation of an aggregate limit will still need to be addressed regardless of how that number is defined.

First, given the uncertainty surrounding the ultimate number of NGSO systems, it is not difficult to foresee a scenario where, even if each NGSO system individually meets a single entry interference limit, aggregate interference levels required for the protection of GSO BSS by NGSO FSS could still be exceeded, especially if technological advances allow for a higher "n" than currently predicted. Thus, GSO operators also need the regulatory assurance that follow-on NGSO systems, asking for as much of the NGSO space, spectrum and interference limit resource as their predecessors, will not cause the aggregate interference limit to be exceeded. Whatever the value for "n" proves to be, it must be clear that the aggregate protection limit will not be expanded, and that the burden will be upon NGSO operators to share the spectrum and interference limit resource.

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35 *Id.*

Second, there are different classes of NGSO systems that may contribute to the interference environment in ways that are not yet fully understood. For example, a quasi-GSO system has very different operational characteristics, and interference does not add in the same way, as a LEO system. This type of co-existence again must be managed in a manner that does not exceed the aggregate limit.

Third, there are potential issues involving the definition of an NGSO system that may permit one NGSO system operator to gain a larger interference allocation than is fair. The Commission will have to address how to fairly apportion the aggregate interference allowed among "n" systems and ensure that the aggregate limit is not exceeded.

These issues are examples of those that must be seriously considered and resolved by the FCC in permitting the operation of NGSO systems and in developing service rules for and in licensing NGSO systems. As a threshold proposition, DIRECTV believes that NGSO operations should not be authorized by the Commission, or individual systems licensed, until the maximum allowable number "n" of NGSO systems has been determined, and the necessary aggregate interference protection limit defined. That limit, which must be divided equitably among "n" systems, will determine the amount of spectrum and interference protection resources each individual NGSO system may utilize.

5. NGSO sidelobe performance and the short-term limit

One of the technical challenges facing NGSO FSS systems in terms of meeting epfd interference limits is the ability of the NGSO system design to meet a short-term interference limit.[36] The short-term limit becomes more important (and typically more stringent)

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36 *Id.* at 34.

as the victim earth station antenna size increases. The short-term epfd limits that DIRECTV has proposed in Technical Appendix A become increasingly more severe as the antenna size of the BSS earth station increases. This increasing severity is necessary to protect these antennas per the requirements of the 10-11S PDNR.

It is important to note that certain NGSO system design parameters can be directly related to the short-term interference performance of the system. For Low Earth Orbit ("LEO") NGSO systems, an important parameter is the amount of roll-off of the NGSO transmitting antenna, especially at points near 10° from the peak of the beam. An improvement in sidelobe performance of several dB can dramatically improve the short-term interference characteristics of an NGSO system.

Significantly, WRC-97 deferred the adoption of final epfd limits until after the technical studies were completed, and ordered that all NGSO systems must comply with the final technical standards. Thus, while NGSO operators may choose to design their systems around the WRC-97 provisional limits, DIRECTV believes that it is critical for NGSO system designers to understand -- and for the Commission to explicitly remind them -- that they are building at their own risk. The deficiencies of the WRC-97 provisional limits are becoming clearer every day. The Commission should expressly confirm that NGSO operators may be required to redesign certain system elements to fully protect GSO BSS and FSS systems.

C. The Commission Must Verify The Operational Integrity Of NGSO Systems Before They Are Licensed

Apart from theoretical sharing issues, the Commission also must take great care to verify the operational integrity of NGSO systems before any such system is licensed to use the 12 GHz band. It is squarely the burden of NGSO system proponents to prove to the Commission

and the GSO satellite industry that their systems will not harm U.S. businesses in which billions of dollars have been invested.

In this regard, the issue of operational integrity of NGSO systems is still very much a question that needs to be addressed. All of the work being done in the Joint Task Group and related technical groups have focused on theoretical models. However, SkyBridge, for example, bases its claimed ability to co-share frequencies on the operational capability of the SkyBridge system to maintain an exclusion zone around GSO satellites by controlling transmitters and handing off transmissions to alternate satellites. This results in existing GSO systems being completely dependent on the ability of the SkyBridge system to carry out satellite-to-satellite handoffs in a reliable and timely fashion under all traffic, propagation and status conditions associated with the SkyBridge system. Realistically, any actual SkyBridge system that is deployed will have limits on external and internal conditions which, if exceeded, will prevent the system from being able to carry out all of the necessary hand-offs in a timely manner.[37]

As DIRECTV has previously stated, SkyBridge to date has relied on claims of "trust us" with respect to the system's operational integrity, redundancy and reliability. Given the enormous U.S. investment in existing GSO systems at Ku band, and given the complexity and immaturity of NGSO systems, those claims are not good enough. It is necessary for GSO

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[37] SkyBridge has stated that it ultimately expects to generate approximately $5 billion in revenue per year, which implies a large amount of traffic on the SkyBridge system, especially in CONUS. Application of SkyBridge, L.L.C., File Nos. 48-SAT-P/LA-97, 89-SAT-AMEND-97 (Feb. 20, 1998) ("SkyBridge Application"), at 95.

systems that may be required to co-exist with NGSO systems to have the means and information to independently ascertain the performance and limitations of the SkyBridge hand-off procedure.

DIRECTV strongly believes that the operational descriptions and system performance of NGSO systems must be supported by data and evidence, such as demonstration programs under experimental licenses, where actual in-the-field performance is independently verified before the system can be deployed on a wide-scale, commercial basis. Such a demonstration phase must include a thorough inspection by the FCC and the GSO industry of all operational software, both terrestrial and satellite, in order to avoid the dire consequences of a failure of SkyBridge's complex interference protection approach. Furthermore, planning for such a demonstration phase can and should begin now. Technical work on NGSO interference has proceeded to the point where the appropriate scope of such a demonstration phase can be defined and the preliminary requirements for such a demonstration phase can be established. The Commission should thus make this precondition to NGSO operations at Ku band.

III. THE COMMISSION MUST REJECT NORTHPOINT'S PROPOSED SERVICE AT 12 GHZ

In the *Notice*, the Commission rightly has decided to "approach cautiously" the idea of introducing Northpoint's proposed terrestrial wireless service into the DBS downlink band.[38] The Northpoint system poses a serious interference threat to DBS operations, and Northpoint's brazen assertions to the contrary are wholly unsupported. Moreover, the policy basis for permitting Northpoint to use 12 GHz spectrum for its proposed operations is extraordinarily weak. The Commission simply should not entertain the notion of permitting Northpoint's terrestrial operations to interfere with the service of millions of DBS subscribers.

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38 *Notice* at ¶ 95.

A. There Is No Question That Northpoint's Proposed Operations Will Create Unacceptable Levels Of Interference To Current And Future DBS Operations

Northpoint persists in blithely ignoring the fundamentals of digital broadcasting by continuing to proffer the fallacious and unsupported claim to Congress and the Commission that it can operate a point-to-multipoint terrestrial system in the same frequency band and in the same geographic area as BSS systems but "not cause interference to DBS users."[39] The claim is wholly unsupported.

As shown in Technical Appendix B, it has become clear that, even operating on a secondary basis relative to primary DBS operations at 12.2-12.7 GHz, Northpoint poses too great of an interference threat to DBS operations to be allowed to provide service in that band. DIRECTV has assigned the Northpoint system an interference impact that is equivalent to one NGSO system (1/5 of the aggregate limit) on overall BSS signal unavailability.[40] According to DIRECTV's analysis, the zone around Northpoint's transmitters where the interference level exceeds international criteria for acceptable inter-service interference occupies *approximately 50%* of Northpoint's proposed service area -- a condition that is a nonstarter from the perspective of reasonable co-existence with DBS systems.[41] Furthermore, the use of mitigation techniques (such as shielding) over such a large interference zone to attempt to manage this interference would be prohibitively costly given that DBS is a ubiquitously deployed, consumer-friendly service that depends in major part upon the ease of installation of DBS antennas. The proposed

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39 *Collier Testimony* at 1.

40 Technical Appendix B at 5-8.

41 *Id.* at 9-17.

Northpoint system, when required to meet the same equitable interference criteria as NGSO systems, fails miserably. Northpoint's proposed operations are simply untenable in the 12 GHz band.

B. Data Gathered As A Result Of By Northpoint's Experimental Testing Is Highly Suspect And Does Not Provide Support For Northpoint's Claims Of Non-Interference With BSS

Northpoint makes sweeping claims that it has tested its system "under experimental license since 1997 and demonstrated that [the Northpoint system] can co-exist without harmful interference to existing DBS services, in both a rural and an urban area."[42] Having observed first-hand portions of Northpoint's experiments[43] and testing methodology, DIRECTV has concluded that Northpoint (i) collected insufficient data to warrant extrapolation of its experimental results (assuming their validity, which DIRECTV does not) to justify nationwide service; (ii) used multiple uncontrolled variables and unrepeatable data collection techniques that render Northpoint's data highly questionable; (iii) used bandwidth test signals and other inputs that did not replicate either real-world or worst-case interference scenarios; and

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42 *Collier Testimony* at 4.

43 DIRECTV and other DBS licensees objected strongly to the grant of an experimental license to Northpoint in an urban environment. DIRECTV still has pending a petition for reconsideration of the grant of an experimental license to Diversified Communication Engineering, Inc., which has been conducting the tests on behalf of Northpoint under station number WA2XMY. *See Experimental License of Diversified Communication Engineering, Inc.*, File No. 6001-EX-MR-1998, Call Sign WA2XMY, Petition for Reconsideration of DIRECTV, Inc. (Aug. 19, 1998); Reply of DIRECTV, Inc. (Sept. 8, 1998). Nevertheless, DIRECTV has made good faith efforts to cooperate with Northpoint's testing in order to acquire meaningful results. Unfortunately, as DIRECTV suspected, Northpoint now seeks to extrapolate these extremely questionable results taken from a single site to fashion a justification for nationwide licensing of its system. DIRECTV's view of the gross deficiencies of Northpoint's experimental license data and testing is discussed further in Technical Appendix B.

(iv) overall, demonstrated a virtual *complete lack of technical understanding of BSS digital transmission.*[44] These experiments are no foundation upon which the Commission can or should contemplate disrupting nationwide DBS operations.

C. Even Accepting Northpoint's Data At Face Value -- Which DIRECTV Does Not -- Northpoint's Own Experiments Show Serious Degradation Of DBS Service

As set forth in Technical Appendix B, accepting at face value the validity of Northpoint's experimental results -- which DIRECTV does not -- Northpoint's own test data show that DIRECTV's service link availability was *seriously degraded at all but one of Northpoint's test sites*, in complete contradiction of Northpoint's claims. Signal meter readings from Northpoint's Austin tests actually confirm DIRECTV's analysis that Northpoint's system will create unacceptable interference for DBS service over a majority of Northpoint's proposed service area.[45] Northpoint's test data show clear interference far beyond the limits of any reasonable sharing criteria. In the 12 GHz band, the Northpoint proposal and system design is plainly incompatible with the provision of quality DBS service.

It is also extremely disingenuous for Northpoint to assert that there is some significance attached to Northpoint's failure to receive "a single call" from DBS subscribers on its customer service hotline "attributable to interference caused by our system"[46] during a month of Northpoint testing in December 1998. First, Northpoint's notice to DBS subscribers of its testing appeared in a small classified advertisement for only one day approximately two weeks

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44 Technical Appendix B at 17-21.

45 *Id.* at 21-24.

46 *Collier Testimony* at 5.

before the December test.[47] It is highly unlikely that this notice was sufficient to give DBS subscribers that may have experienced visible interference adequate knowledge of Northpoint's hotline in order to voice their complaints.

More fundamentally, the interference effects evidenced by the Northpoint data are long-term and cumulative. Because of the DIRECTV service's substantial "clear weather" signal margins, Northpoint signals may not always cause visible disruption to DIRECTV's digital signals. However, if the Northpoint system is actually deployed, the interference that it will create in the 12 GHz band over time will lower these clear weather margins and cause a significantly increased number of downlink rain outages which , for example, will last for increasingly longer periods of time.[48] These effects might not manifest themselves in a month-long test, but the interference created by the Northpoint system has been evidenced nonetheless. Regardless of whether Northpoint interference completely eliminates a subscriber's picture, its consequences are no less severe for DBS subscribers, who have come to expect picture quality, service availability and reliability that is superior to that provided by other MVPDs, including incumbent cable television operators.

D. There Is Nothing Novel About The Northpoint Approach

It would be especially problematic to jeopardize current and future DBS operations when the technology that Northpoint proposes to introduce into the 12 GHz band is

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47 A copy of Northpoint's Affidavit of Publication, including the advertisement, is included as Attachment C.

48 *See* Appendix B at 27.

neither novel nor beneficial from a consumer service standpoint. Although Northpoint describes its system as "an exciting new technology,"[49] it is nothing of the kind.

Conceptually, Northpoint's technology is grounded upon the same frequency reuse methodology that has been used for decades to engineer terrestrial microwave systems when additional spectrum is required. The basic problem with Northpoint's approach, however, is that it generally requires coordination among frequency users. This coordination is of course achievable among professionally engineered microwave systems, but is far more difficult when imported into the DBS downlink band, where users are not required to coordinate and the band itself was envisioned by the Commission to be clear of terrestrial services.[50]

In addition, Northpoint proposes nothing "new" as a service. Functionally, Northpoint's system is no different than other terrestrial multipoint video distribution services, such as MDS and LMDS. And Northpoint has not shown why it must use the 12 GHz band to provide such service when the Commission has already provided spectrum for MDS services (including two-way operations),[51] set aside vast amounts of spectrum for LMDS operations, and provided for high density terrestrial services at 38 GHz.[52] In light of these allocations, polluting the DBS downlink band with Northpoint transmitters where there is other spectrum expressly allocated for two-way terrestrial video and data services is both unnecessary and unwise.

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49 *Collier Testimony* at 2.

50 *See* R. Conover, Senior Vice President of Engineering, US Satellite Broadcasting Co., *Northpoint interference problems* (Feb. 18, 1999) ("Conover"), at 1.

51 *See MDS Two-Way Order*, 13 FCC Rcd 19112 (rel. September 25, 1998).

52 *See Notice* at ¶ 93.

Northpoint's sole attachment to the 12 GHz band seems to be based on a belief that operating there will allow its service to be provided more cheaply by requiring minimal changes to existing DBS equipment. That reasoning is flawed in two respects. First, there is no question that a Northpoint subscriber will require a separate, additional antenna and LNB to receive Northpoint services no matter what frequency band is used. These services can downconvert from other frequency bands as easily as they could from 12 GHz. Second, Northpoint's new emphasis on the competitive[53] rather than complementary nature of its service relative to DBS providers highlights the fact that there is no need for Northpoint equipment to be compatible with DBS.

The bottom line is that Northpoint does not need to use the 12 GHz band to have a successful service. Northpoint should focus on other bands where coordination with other users will be manageable, and not on the 12 GHz band, where it will impede DBS service reception for millions of U.S. subscribers.[54]

E. Re-Introducing Sources Of Terrestrial Interference Into The 12.2-12.7 GHz Band Runs Completely Counter To The Commission's Prior Efforts To Promote DBS Service Development

The concept of introducing a terrestrial interference source into the BSS downlink band is anathema to the Commission's historical efforts to protect DBS operations from sources

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53 Northpoint initially garnered media and Congressional attention, and presumably hoped to divert the attention of the DBS industry for a time, by claiming to have hit upon a unique way of allowing DBS consumers to receive local broadcast channels through a complementary terrestrial service. Northpoint, however, now describes its system as a "standalone" MVPD service with "enough capacity to carry at least 96 channels" and an expectation of offering "programming packages that offer our customers dozens of cable-like channels in addition to their local stations," *Collier Testimony* at 7, as well as "high-speed Internet services." *Id.* at 8.

54 Conover at 4.

of terrestrial interference. For nearly two decades, the Commission has worked to transition terrestrial point-to-point licensees *out* of the 12 GHz band, explicitly recognizing the interference threat that such licensees pose to BSS service even when operating on a secondary basis.[55] To re-introduce a far more significant and ubiquitous terrestrial interference threat at this critical juncture in the development of DBS service makes little policy sense.

Moreover, now that Northpoint has unveiled its intention to become a direct MVPD competitor to DIRECTV, it is not plausible to believe that Northpoint will "immediately eliminate interference" or "cease operations immediately" as required by its secondary status in the event that Northpoint's operations interfere with subscribers' receipt of DBS signals.[56] While DIRECTV has no qualms at all about competing with Northpoint in the MVPD marketplace, Northpoint's incentives as a competitor using the DBS downlink band will be to dispute any claims of harmful interference by DBS operators, and indeed, Northpoint may have perverse incentives not to mitigate harmful interference at all. Northpoint's interference into DBS receivers will seriously degrade DBS subscribers' quality of service. Furthermore, DBS subscribers will have no way of knowing that Northpoint is the source of the problem, or that Northpoint is the entity with the obligation to fix it.[57] Such a threat to the superior quality of

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55 *See, e.g.*, Public Notice, *Initiation of Direct Broadcast Satellite Service -- Effect on 12 GHz Terrestrial Point-to-Point Licensees in the Private Operational Fixed Service*, 10 FCC Rcd 1211 (1994) (explicitly reminding remaining 12 GHz terrestrial licensees of their secondary status, and stating that "[i]n view of the imminent arrival of DBS service, terrestrial 12 GHz licensees should again consider relocating their operations to other available frequency bands or alternative facilities").

56 *Id.*

57 *See* Conover at 2.

service currently provided by DBS systems in the United States should not be tolerated by the Commission.

F. Northpoint Proposes A Cumulative Interference Source With Little Public Benefit That Must Not Be Allowed To Impair DBS Services

It is clear that the use of the 12.2-12.7 GHz band by primary or secondary services, at any power level, increases the operational noise floor for DBS systems. This fact reduces DBS link availability and thus reduces the quality of DBS service. As mentioned, DBS providers in the United States, led by DIRECTV, are already attempting to assess the potential effects of the introduction of NGSO operations at 12 GHz. Furthermore, as the Commission is well aware, there are still many secondary users in the 12.2-12.7 GHz band. Although the operations of these secondary users have posed a significant risk to DBS operations, DIRECTV over the past five years has worked with many of these users in conjunction with DIRECTV subscribers to resolve specific cases of interference as they have arisen.[58]

The Commission cannot expect the DBS service to continue to grow as the most prominent cable-competitive service if a number of different interference sources are introduced into its downlink band. The prospect of now introducing thousands of additional point-to-multipoint broadcast towers into the 12 GHz band, as Northpoint has proposed, will add even more system noise at 12 GHz that will be cumulative with respect to the system noise produced

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58 As primary users of the band, DIRECTV has the right to request the Commission to shut down secondary terrestrial users that interfere with DIRECTV subscribers' receipt of service. *See* Public Notice, *Initiation of Direct Broadcast Satellite Service -- Effect on 12 GHz Terrestrial Point-to-Point Licensees in the Private Operational Fixed Radio Service*, 10 FCC Rcd 1211 (1994). In an effort to resolve such situations cooperatively, DIRECTV has relocated subscriber dishes at its own expense or otherwise reduced the interference to acceptable levels.

by NGSO and existing terrestrial point-to-point systems. Over time, the DBS downlink band will become interference-limited, which will *eliminate* the possibility of future technical innovation by DBS operators. That would be a disastrous public policy and consumer result.

DIRECTV submits that attempting to accommodate Northpoint operations at 12 GHz simply is not close to being worth the interference risk the technology poses to DBS operations. Any attempt to facilitate development of the service that Northpoint proposes should focus on accommodating Northpoint in frequency bands where the interference effects of the Northpoint system can be more easily managed.

IV. CONCLUSION

The Commission should proceed extremely cautiously in considering the introduction of potential interference sources into the frequency bands that are fundamental to the provision of DBS service. While progress has been achieved in understanding how successful sharing and coordination among NGSO systems and DBS operators might be achieved, much remains to be done before the Commission can or should proceed with authorizing NGSO FSS operations, promulgating NGSO FSS service rules or assigning NGSO FSS licenses.

The Commission should reject the proposed secondary operations of the Northpoint system at 12 GHz. Northpoint's system poses an unacceptable risk of interference with DBS operations, is not innovative, is duplicative of existing services and is more appropriately accommodated in other frequency bands.

Respectfully submitted,

DIRECTV, INC.

By: _____

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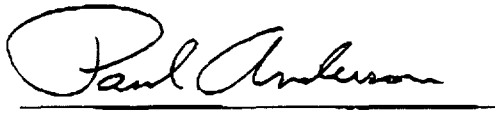
DECLARATION OF PAUL R. ANDERSON

I, Paul R. Anderson, hereby declare as follows:

1. I am Director, Communications Systems for DIRECTV Enterprises, Inc. I am an engineer by training and am familiar with the technical and interference characteristics of DIRECTV's Direct Broadcast Satellite system, the technical requirements of the Commission's and International Telecommunications Union ("ITU") rules, and the interference and technical issues referenced in the foregoing filing and attached technical appendices.

2. I have reviewed the foregoing filing and attached technical appendices from a technical perspective, and the information found therein is true and accurate to the best of my knowledge, information and belief.



Paul R. Anderson
Director, Communications Systems
DIRECTV Enterprises, Inc.

March 1, 1999

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TECHNICAL APPENDIX A:
ANALYSIS OF BSS-NGSO SHARING ISSUES
DIRECTV, INC.
March 2, 1999

1 Background

WRC-97 allocated the 12.2 to 12.7 GHz BSS band in Region 2 for NGSO FSS use on a co-primary basis, and established provisional interference limits to protect current and future BSS operations in this band. These provisional limits were established without the benefit of extensive technical analyses, which were then and still are clearly needed to ensure protection of the BSS. Extensive technical analysis is required because of two important factors: First, the BSS has been developed in the United States using technical parameters that are different from those listed in Annex 5 of Appendix 30 to the ITU Radio Regulations. Protection requirements for these U.S. BSS systems clearly need to take these different parameters into account to ensure healthy growth of BSS services in this country. Second, the NGSO interference source is one source whose interfering signal level varies widely with time. It is very important to: (i) acknowledge this time varying aspect, (ii) quantify its characteristics, and (iii) use these characteristics to reach an acceptable agreement on interference limits.

In the 14 months that have elapsed since WRC-97, much significant progress has been made with respect to developing the technical assumptions necessary to competently revise the WRC-97 provisional limits to achieve adequate protection of the BSS. This progress includes the establishment of appropriate BSS protection criteria, the development of an accurate methodology to evaluate candidate interference limits against the protection criteria, and a better understanding of the interference characteristics of NGSO FSS systems as they apply to the BSS.

In particular, BSS protection criteria and an evaluation methodology were proposed in a Preliminary Draft New Recommendation (PDNR) written during the JWP 10-11S meeting in Geneva, Switzerland in October 1998. This work by JWP 10-11S was very important in establishing new criteria pertinent to the NGSO-BSS sharing situation.

Two independent implementations of the evaluation methodology described in the PDNR have been developed: one by SkyBridge in France and the other by DIRECTV in the United States. These implementations agree quite well with one another, and are now both considered by JTG 4-9-11 as competent implementations of the evaluation methodology (See JTG 4-9-11/TEMP/ 93, January 29, 1999).

Because of the time varying nature of the interference and the capabilities of these evaluation tools, interference limits have now taken the form of interference limit masks representing equivalent power flux density. A definition of equivalent power flux density, or "epfd," can be found in footnote 1 of Annex to Resolution 538 (WRC-97). These masks allow for more efficient accommodation of the needs of both the GSO community and the NGSO community.

These developments now enable the establishment of interference limits masks that fundamentally protect the primary BSS service in the United States using 45, 60, 90, 120, 180, and 240 cm subscriber antennas.

It must also be pointed out that basing interference limits on epfd does have certain drawbacks that must still be addressed. These include the need to define both aggregate and single entry masks, and the need to establish an effective number of operating NGSO systems in a given frequency band. In addition, the definition of epfd stipulates that interference limit masks are dependent on the characteristics of the victim receiving antenna. This in turn will create a large set of interference limits for a given band. These and other drawbacks must be adequately addressed before the concept of epfd is adopted as the quantitative interference measuring parameter.

2 Recommended BSS Protection Policy

In responding to the Notice of Proposed Rulemaking, DIRECTV takes the following position on the derivation of suitable interference masks to protect BSS in the United States:

1. The protection criteria as defined in the JWP 10-11S PDNR (and as modified by JTG 4-9-11 at its recent meeting in Long Beach, California) *must be met* for all BSS links.

2. Either of the two implementations of the PDNR evaluation methodology -- the DIRECTV implementation or the SkyBridge implementation -- may be used to evaluate candidate aggregate epfd limits.

3. For any given antenna size of interest, an aggregate interference limit mask that meets the requirements stated in points (1) and (2) above for all BSS links is acceptable, regardless of its shape. That is, the required amount of protection can be provided by a variety of mask shapes.

4. Single entry interference masks are derived from an acceptable aggregate mask shape. This is done using an assumed number of NGSO FSS systems that could share the same spectrum. A strong regulatory mechanism is needed to ensure that whatever the eventual number of operating NGSO systems proves to be, the aggregate limit is never exceeded.

The protection criteria established by 10-11S, the evaluation methodology and its implementation by DIRECTV, the clear inadequacy of the WRC-97 provisional limits, derivation of a candidate mask shape, and proposed interference limit masks are described in detail below.

3 Protection Criteria

Document JWP 10-11S/TEMP 41, a preliminary draft new recommendation entitled "Protection of the Broadcasting Satellite Service in the 12 GHz Band and Associated Feeder Links in the 17 GHz Band from Interference Caused by NGSO FSS Systems", proposes protection criteria for the broadcasting satellite service. These are as follows:

recommends

1 that for a GSO/BSS network in the 12 GHz band and its associated feeder links in the 17 GHz band, the aggregate inter-network interference caused by the earth and space station emissions of all NGSO-FSS satellite networks operating in the same

frequency band, should:

1.1 be responsible for at most 10% of the time allowance(s) for unavailability of the given C/N value(s) as specified in the performance objectives of the desired network, where N is the total noise level of the wanted carrier including all other non-time-varying sources of interference;

1.2 not lead to loss of synchronization in the desired GSO BSS and associated feeder-link network under clear sky conditions;

Recommends 1.1 ensures that NGSO interference does not significantly degrade the signal availability performance of BSS systems. This is an important area of protection for BSS systems that use small-diameter user antennas. BSS providers in the United States are continually searching for ways to improve the quality of BSS service. A degradation in signal availability beyond the 10% degradation level specified in the PDNR would clearly be an unacceptable degradation in quality of service.

Recommends 1.2 ensures that under clear sky conditions there is never a loss of synchronization in a BSS link. Very occasional loss of service due to heavy rainfall is recognized by subscribers as unavoidable, and is due to the basic physics of rain attenuation. Higher power satellites can and will reduce the length and number of such outages, but these types of outages can never be effectively eliminated. However, loss of synchronization and the attendant complete loss of picture under clear sky conditions would be perceived by subscribers as avoidable, and thus if such events are allowed to occur would be seen as a severe degradation in service quality. Adherence to this requirement is thus critical to quality of service. The loss of synchronization issue is discussed in detail in section 5.2.

These simple protection criteria can be met by a variety of epfd protection masks for a given antenna size. Specific epfd protection masks are recommended below, and shown to meet the above criteria using the JTG 4-9-11 approved evaluation methodology.

4 BSS Links to be Protected

Joint Working Party 10-11S through a Special Rapporteur has been accumulating information on BSS links that are to be protected. These BSS links include a large number of BSS links that serve the United States. These links serving the U.S. will be considered herein in the development of interference limit masks. The links along with their identification are included in Annex 1.

Included in this listing are links that are representative of future technologies that are likely to be incorporated into the BSS. These include 8PSK operation (see link US-GSO D4) and links with improved low noise amplifier performance (see links US-GSO D6(a) and D6(b)). All of the protection masks proposed in Section 8 protect these links as well as existing QPSK service to present day low noise amplifiers.

5 Evaluation Methodology and Its Implementation

5.1 Evaluation Against '*recommends* 1.1' of the PDNR

5.1.1 Implementation of the Evaluation Methodology

An evaluation methodology to demonstrate compliance with the criteria in *recommends* 1.1 also is included in the PDNR. It combines the statistical properties of NGSO interference with the statistical properties of rain degradation. The result of this evaluation quantifies the amount of degradation in unavailability that can be expected in a particular link.

A Monte Carlo technique is used in the DIRECTV implementation of this methodology. Annex 2 provides this evaluation methodology in detail. The results of the Monte Carlo technique compare favorably with the SkyBridge implementation of the evaluation methodology. The SkyBridge implementation systematically covers all possible combinations of the uplink fade, the downlink fade, and the NGSO interference level.

A comparison case can be seen in Table 5-1, which summarizes the results of evaluating the impact of the provisional limit on a specific US BSS link (US-GSO 1(a)). Note that the provisional limit is a single entry limit, and the values in Table 5-1 represent one NGSO system operating at the provisional limit. These calculations do not include rain fade attenuation on the interference.

Link US-GSO 1(a)	Monte Carlo Evaluation	Systematic Evaluation
epfd limit, 100% (short term), $dBW/m^2/4kHz$	-165.3	-165.3
epfd limit, 99.7% (long term), $dBW/m^2/4kHz$	-174.3	-174.3
Availability without NGSO Interference	99.923	99.903
Availability with one system at provisional limit	99.913	99.891
Percent increase in unavailability	13.0%	10.9%

Table 5-1: Evaluation of Link US-GSO 1(a) and the Provisional Limit

5.1.2 Interpretation of the Increase in Unavailability

In order to fairly apportion the unavailability increase allowed in *recommends* 1.1 of the PDNR for both operational and planned BSS links, it is necessary to calculate link availability both with and without NGSO interference. The percent increase in unavailability over the unavailability performance obtained without NGSO interference is then compared with the 10% criteria. The unavailability without NGSO interference is calculated per the link parameters supplied in the BSS link database. This calculated availability will be interpreted as the *de facto* performance objective of the BSS link.

In operational links, achieved performance clearly becomes the *de facto* performance objective through extensive customer experience. Any stated performance objectives become irrelevant to actual field experience.

In planned links, where a stated performance objective may be exceeded with margin, it also is appropriate to calculate the availability using the supplied link parameters and use this calculation as the *de facto* performance objective rather than use the stated performance objective. In this case, any link margin available beyond that required to achieve a performance objective should largely remain available to the system designer to offset risky link design issues (such as the accuracy of rain models or the un-quantified effects of antenna surface wetting).

5.2 Evaluation Against *'recommends* 1.2' of the PDNR

5.2.1 Revised Meaning of 'Loss of Synchronization' for BSS Systems

JTG 4-9-11, at its January 1999 Long Beach meeting, wrote a liaison statement to JWP 10-11S advising that group to modify the wording of *recommends* 1.2 concerning the meaning of the words 'loss of synchronization'. (*See* JTG 4-9-11/TEMP/93, January 29, 1999). For the BSS, where digital video is being transmitted, an appropriate link performance point for 'loss of synchronization' is the point at which a freeze frame condition occurs. At this link performance point the input bit error rate to an MPEG 2 video decoder is sufficiently degraded to cause the decoder to skip the presentation of entire video frames (pictures). This performance point is not necessarily the same performance point at which the demodulator loses carrier lock, but is certainly the point at which a major disruption of service occurs for the subscriber. As noted in Section 3, it is unacceptable for this condition to occur under clear sky conditions, for this would be perceived by subscribers as avoidable, and thus would be seen as a severe degradation in service quality.

Calculations will show that the short-term epfd levels proposed in this Appendix satisfy the provisions of *recommends* 1.2.

5.2.2 Method to Determine if Freeze Frame Condition will Occur

To determine if a freeze frame condition could occur, a simple link budget is generated assuming clear sky conditions and the presence of an interfering signal at the maximum amount allowed by the proposed interference limit mask. If a positive margin exists after the addition of the interfering signal, then the condition of *recommends* 1.2 is satisfied.

The Region 2 BSS link budgets used in this analysis were submitted to the Special Rapporteur Group 2 (SRG2) of JWP 10-11S. An example of this calculation for the link US-GSO 1(a) is shown in Table 5.2.2-1. The NGSO interference, represented by the short-term epfd limit for the 45 cm earth station antenna in row 1, is translated into a C/I value, and then used in the link budget calculation. The short-term epfd limits and the overall epfd limits for different antenna sizes are discussed in section 8. If the "Clear sky C/N+I total margin above operating threshold" in row 57 is positive, the link will not suffer freeze frames under clear sky conditions, and the criterion of *recommends* 1.2 is satisfied. Per the recent findings of JTG 4-9-11 (as described in 4-9-11/TEMP/93), "C/N+I required for

operating threshold" in row 15 is 1.5 dB below the nominal value specified for this parameter in the link budget. This is done because the C/N+I which produces freeze frames was recognized by JTG 4-9-11 to be about 1.5 dB below the value specified in the SRG2 link budgets.

1	NGSO epfd	dB(W/m2/4kHz)	-165
2			USA
3	**BSS Assignment characteristics**	**Units**	**US-GSO 1(a)**
4	**System Characteristics**		
5	Frequency	GHz	12.700
6	Availability objective	%	99.92
7	**Calculated availability due to rain up and downlink (Rec P 618-5)**	%	
8	**Calculated availability due to rain downlink (Rec P 618-5)**	%	
9	**Calculated availability due to rain uplink (Rec P 618-5)**	%	
10	Receiver noise Bandwidth	MHz	24
11	Modulation type		QPSK
12	C/I due to other GSO BSS networks	dB	20.7
13	***C/I due to NGSO FSS networks***	dB	12.5
14	*Clear sky feeder link C/N+I*	*dB*	*24.2*
15	C/N+I required at operating threshold	dB	3.5
16	Clear sky C/N+I margin above operating threshold (1)	dB	3.6
17	**Total Clear sky C/N+I margin above operating threshold (1)**	dB	
18	**Available clear sky downlink rain margin above threshold**	dB	
19	**Available clear sky uplink rain margin above threshold**	dB	
20	C/N+I total link for 99.7% of the time	dB	
21	C/N+I margin above operating threshold for 99.7% of the time	dB	2.0
22	C/N+I total link margin above operating threshold for 99.7% of the time	dB	
23	**Space station characteristics**		
24	Longitude	°	101W
25	Satellite e.i.r.p. in the direction of the earth station	dBW	48
26	**Earth station characteristics**		
27	Receive antenna diameter	cm	45
28	*Receive antenna efficiency*	*%*	*70*
29	On-axis antenna gain at receiver input	dBi	34
30	**On-axis antenna gain at antenna output**	**dBi**	
31	Off-axis antenna gain characteristics		App 30, An. 5
32	Clear sky receive system noise temperature at receiver input	K	125
33	Clear sky receive system noise temperature at antenna output	K	
34	*Clear sky G/T*	*dB/K*	*13*
35	Total pointing loss	dB	0.5
36	Location of earth station		
37	Latitude	°	47.6
38	Longitude	°	122.3W
39	Altitude	km	
40	Rain climatic zone		D
41	Elevation angle	°	31.5
42	**Propagation characteristics**		
43	*Slant path*	*km*	*38500*
44	*Free space loss*	*dB*	*206.2*
45	*Atmospheric absorption*	*dB*	*0.2*
46	Rain attenuation for 99.7% of the time	dB	0.80
47	*Noise increase due to rain for 99.7 % of the time*	*dB*	*1.4*
48	Wanted pfd received at earth station	dB(W/m2)	
49	Rain attenuation for availability percentage of time	dB	1.50
50	*Noise increase due to rain for availability percentage of time*	*dB*	*2.2*
51	**Downlink budget clear sky**		
52	*C/N thermal clear sky downlink*	*dB*	*8.9*
53	*C/N+I clear sky downlink*	*dB*	*7.1*
54	*C/N+I clear sky total link*	*dB*	*7.1*
55	Clear sky C/N downlink margin above operating threshold	dB	5.4
56	Clear sky C/N+I downlink margin above operating threshold	dB	3.6
57	Clear sky C/N+I total margin above operating threshold	dB	3.6

Table 5.2.2-1 Example of 'loss of sync' calculation for link US-GSO 1(a)

Similar calculations were performed for the SRG2 links providing service to the United States. It was found that the criterion of recommends 1.2 is satisfied for these links using the short-term epfd level cited in section 8 for the various antenna sizes.

6 Evaluation of WRC-97 Provisional Limits

6.1 A Single NGSO FSS System at the Provisional Limit for 45 cm Antennas

The evaluation comparison of the provisional limit discussed in Section 5 can be used to show that the WRC-97 provisional epfd limit must be modified for at least the 45 cm antenna size in Region 2.

The last row of Table 5-1 shows that a single NGSO system operating at the provisional limit causes an 13% increase in unavailability for this BSS link, when analyzed using the Monte Carlo technique. An increase of greater than 10% occurs when these conditions are analyzed using the methodology implementation developed by SkyBridge. Clearly two or more NGSO systems each operating at the provisional limits will then cause degradation far beyond the aggregate 10% criterion. Hence, the WRC-97 provisional limits clearly must be modified.

6.2 Five NGSO FSS Systems at the Provisional Limits

Table 6.2-1 shows the effects of five NGSO FSS systems operating at the WRC-97 provisional limits at various antenna sizes. The BSS links analyzed come from either links that currently exist in the JWP 10-11S Special Rapporteur data base, or that are about to be submitted to that data base. The links at the 240, 180 and 120 cm antenna sizes include important links that serve thousands of customers in Juneau and Anchorage, Alaska.

Link	Percent increase in unavailability with five NGSO systems each at the provisional limit
US-GSO D4 (45 cm)	116%
US-GSO D15 (120 cm)	37%
US-GSO 16 (180 cm)	1800%

Table 6.2-1 Percentage increase in unavailability with five NGSO FSS Systems each operating at the WRC-97 Provisional Limits

Again, the provisional limits are shown to be clearly inadequate for the protection of 45,120 and 180 cm antennas per the criteria set out in the PDNR.

7 Single Entry EPFD Mask Development Process

7.1 Overview of Mask Development Process

The PDNR includes the following stipulation:

recommends

2 that the equivalent power flux-density (epfd) and aggregate power flux-density (apfd) limits as defined in Article S22 of the Radio Regulations and applicable respectively to NGSO FSS systems to be operated in the 12 GHz bands shared with BSS and in the 17 GHz frequency bands shared with BSS feeder links be derived and specified in such a way:

2.1 that they satisfy the criteria in *recommends* 1.1 and 1.2 above when applied to a set of representative GSO BSS and associated feeder-link system characteristics, as provided in Annex 1 to this Recommendation;

2.2 that the apportionment of the aggregate interference allowance specified in *recommends* 1.1 and 1.2 to derive single entry limits be based on the number of NGSO FSS systems that are anticipated to share the same frequency bands;

2.3 that these limits are specified by continuous curves of cumulative density function for a range of representative GSO receiving antenna sizes;

The following steps can be followed to provide limits consistent with the PDNR:

a. Define an appropriate epfd mask shape.

b. Using this shape and the proposed methodology, evaluate appropriate BSS links from the JWP 10-11S SRG2 database. For this evaluation, the mask is used as an aggregate epfd mask.

c. Set the aggregate mask values to protect the most sensitive BSS link at the protection levels found in *recommends* 1.1 and 1.2.

d. Using the anticipated number of NGSO systems that could share the same frequency band, derive a single entry epfd mask from the aggregate mask established in item (c).

These steps can be followed for any given antenna size of interest.

7.2 Development of an Interference Mask Shape

A three-segment epfd mask is proposed. The three segments, labeled A, B and C, are shown in Figure 7.2-1.

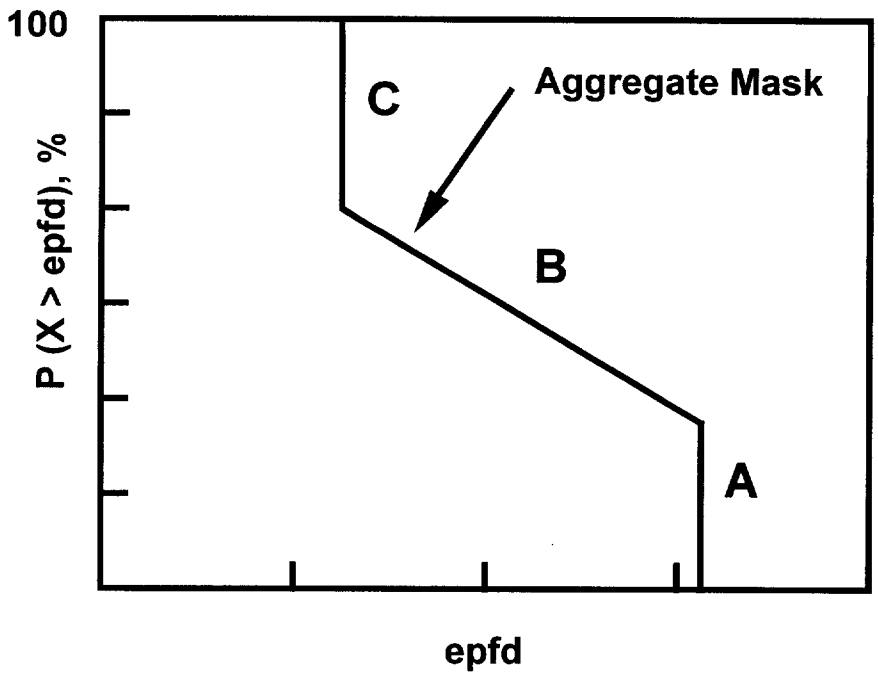

Figure 7.2-1 Aggregate epfd Mask

7.2.1 Short-Term Regime (A)

The epfd level for segment A is primarily a function of the requirement that there be no loss of synchronization under clear sky conditions (*recommends* 1.2). The epfd level for segment A is set by examining the link budget margin under clear sky conditions, and by examining the behavior of the combined effect of this short-term epfd limit and rain degradation. It has generally been found that the epfd value for segment A must be set such that a significant positive link margin is maintained in clear sky conditions. If this is not done, then it becomes very difficult to meet the 10% limit criteria for unavailability degradation.

7.2.2 Transition Regime (B)

This part of the mask accommodates typical NGSO interference behavior between the short-term portion of the mask (A) and the long-term portion of the mask (C). The slope is determined by the roll off characteristics of the victim earth station antenna pattern. This is described in detail in section 2.4 of Annex 2.

The vertical position of the B segment is established by requiring that NGSO short-term events do not add significantly to BSS link outages, consistent with *recommends* 1.2. Note that segment C establishes a long-term noise level, and this acts in the long term to degrade BSS system unavailability. From a link analysis and design standpoint, it is best if this long-term level is the dominant term causing increased link unavailability. Designers of future systems may be able to estimate the impact of NGSO interference on small diameter receive BSS earth station by using a single epfd value (that of segment C), and then to estimate the subsequent degradation in availability due to the aggregate NGSO

sources.

7.2.3 Long-Term Regime (C)

The epfd level for segment C follows from the requirement that the aggregate impact on BSS link unavailability be less than 10%. (*recommends* 1.1). It is set by evaluating the impact on BSS link unavailability for various values of segment C epfd. The epfd value is adjusted until a 10 % degradation of unavailability is achieved for the complete mask. A variation of this portion of the mask is to change segment C from a vertical line to a line with a slope, where the slope is steeper than that used for segment B.

7.3 Derivation of a Single-Entry epfd Mask from an Aggregate Mask

It is assumed here that multiple NGSO systems add in power in the long term to reach an aggregate noise level. Once the aggregate mask is determined, the long-term portion of the single entry mask can be determined by taking the epfd value of segment C of the aggregate mask and reduce it in power by 10log(n). This gives the epfd value of segment C of the single entry mask. The variable n is the anticipated number of NGSO systems that could share the same frequency band.

It is assumed here that multiple NGSO systems will add in time in the short-term to reach an aggregate time value. Again, once the aggregate mask is determined, the short-term portion of the single entry mask can be determined by taking the time value of segment A of the aggregate mask and dividing this by n. This gives the time value of segment A of the single entry mask. The epfd value of segment A would not change.

Figure 7.3-1 shows the relative relationship between the single entry mask and the aggregate mask.